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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application No.: 10/090,489
Filed: March 4, 2002
Inventor(s):
Ranjit S. Oberoi, Michael G. Lavelle, Anthony S. Ramirez and Brian D. Emberling

Title: SLICE BLEND EXTENSION FOR ACCUMULATION BUFFERING

Examiner: Woods, Eric V.
Group/Art Unit: 2672
Atty. Dkt. No: 5681-14000

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, Alexandria, VA 22313-1450, on the date indicated below.

Jeffrey C. Hood

May 30, 2006 — Date
Signature

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir/Madam:

Further to the Notice of Appeal filed March 27, 2006, Appellants present this Appeal Brief. Appellants respectfully request that this appeal be considered by the Board of Patent Appeals and Interferences.

I. REAL PARTY IN INTEREST

The subject application is owned by SUN MICROSYSTEMS, INC., a corporation organized and existing under and by virtue of the laws of the State of Delaware, and having its principal place of business at 901 San Antonio Road, Palo Alto, CA 94303, as evidenced by the assignment recorded at Reel 012997, Frame 0536.

II. RELATED APPEALS AND INTERFERENCES

No other appeals, interferences or judicial proceedings are known which would be related to, directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 7-10, 17-22, and 25-33 are pending and rejected. The rejection of claims 7-10, 17-22, and 25-33 is being appealed. A copy of claims 7-10, 17-22, and 25-33 is included in the Claims Appendix hereto.

IV. STATUS OF AMENDMENTS

No amendments to the claims have been submitted subsequent to the final rejection.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 7 is directed to a method comprising: (a) reading a first stream of image pixels corresponding to an image X_K from an image memory; (b) reading a

second stream of pixels corresponding to an image A_K from an accumulation buffer; (c) blending each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generating a third stream of output pixels defining an image A_{K+1}; (d) transferring the third stream of output pixels to the accumulation buffer; (e) performing (a), (b), (c) and (d) for each image after the first image of a sequence of N images X_K, for K = 0, 1, 2, ..., N-1 (*as disclosed at least at page 16, lines 1-26, and at page 18, lines 2-22, of the specification*).

Independent claim 17 is directed to a system comprising: an accumulation buffer; an image memory for storing a sequence of N images X_K, wherein K=0, 1, 2, ..., N-1; and a mixing unit configured to:

(a) read a first stream of image pixels corresponding to an image X_K from the image memory,

(b) read a second stream of pixels corresponding to an image A_K from the accumulation buffer,

(c) blend each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generate a third stream of output pixels defining an image A_{K+1}, and

(d) transfer the third stream of output pixels to the accumulation buffer;

wherein the mixing unit is further configured to perform (a), (b), (c) and (d) for each image after the first image of the sequence of N images

(*as disclosed at least at page 2, lines 3-11, and page 16, lines 1-26, of the specification*).

Independent claim 25 is directed to a system comprising: a memory for storing a plurality of 2D images X_K, wherein the plurality of 2D images include a sequence of at least N slices through a 3D image representing one or more 3D objects; an accumulation buffer; and an accumulation unit configured to accumulate a composite image of a sequence of N of the 2D slices by reading a first 2D image of the sequence and storing it in the accumulation buffer; wherein the accumulation unit is further configured for each of the second through the Nth image of the sequence of N images to:

(a) read a first stream of image pixels corresponding to a current image X_K of the sequence of images from the memory,

(b) read a second stream of pixels corresponding to a current image A_K from the accumulation buffer,

(c) blend each image pixel of the current image X_K with the corresponding pixel of the image A_K based on a weight provided with the image pixel, to generate a third stream of output pixels defining an image A_{K+1}, and

(d) replace corresponding pixels in the accumulation buffer with the third stream of output pixels

(*as disclosed at least at page 2, lines 3-11, and page 16, lines 1-26, of the specification*).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 7, 9, 10, and 17 are rejected under 35 U.S.C. §103(a) as being unpatentable over Morein (USPN 6457034) in view of Haeberli et al., Journal Publication (Computer Graphics, v24, n4, August 1990), and further in view of MacInnis et al. (USPN 6570579).

2. Claims 8, 18, 19, and 22 are rejected under 35 U.S.C. §103(a) as being unpatentable over Morein (USPN 6457034) in view of Haeberli et al., Journal Publication (Computer Graphics, v24, n4, August 1990) and MacInnis et al. (USPN 6570579), and further in view of McReynolds ("Programming with OpenGL: Advanced Techniques". Siggraph Conference 1997, Course Notes for Course #11).

3. Claims 20-21 and 24-33 are listed as rejected in the Office Action Summary, however, there are no stated grounds of rejection of claims 20-21 and 24-33 presented in the Final Office Action of December 27, 2005.

VII. ARGUMENT

First Ground of Rejection:

Claims 7, 9, 10, and 17 are finally rejected under 35 U.S.C. §103(a) as being unpatentable over Morein (USPN 6,457,034) in view of Haeberli et al., Journal Publication (Computer Graphics, v24, n4, August 1990, herein referred to as Haeberli), and further in view of MacInnis et al. (USPN 6,570,579; hereinafter referred to as MacInnis). Appellants traverse this rejection for the following reasons. Different groups of claims are addressed under their respective subheadings.

Claims 7- 10, and 30-31

Applicant respectfully submits that Morein, Haeberli, and MacInnis either singly or in combination do not teach or render obvious a method as recited in claim 7 comprising: (a) reading a first stream of image pixels corresponding to an image X_K from an image memory; (b) reading a second stream of pixels corresponding to an image A_K from an accumulation buffer; (c) blending each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generating a third stream of output pixels defining an image A_{K+1}; (d) transferring the third stream of output pixels to the accumulation buffer; (e) performing (a), (b), (c) and (d) for each image after the first image of a sequence of N images X_K, for $K = 0, 1, 2, \ldots, N-1$.

Morein does not teach a blending process that includes "reading a second stream of pixels corresponding to an image A_K from an accumulation buffer and blending each image pixel of the image X_K with the corresponding pixel of the image A_K". The blending process taught by Morein does not read a stream of pixels from an accumulation buffer corresponding to an image A_K, but instead accomplishes a blending operation by simply adding image X_K pixel data directly to the accumulation buffer as described at column 5, line 61 through column 6, line 12:

"The first accumulation buffer 170 stores an accumulation data set for each pixel of the frame. Each accumulation data set includes accumulated color data and a counter value. Blending color data from the drawing buffer 140 with that stored in the first accumulation buffer 170 may be accomplished by simply **adding** the color data stored in the drawing buffer 140 to the accumulated color data stored in the first accumulation buffer 170. For example, if the color data includes red, green, and blue color portions, the value for each of these color portions in the drawing buffer 140 will be added to the value for each of the portions currently stored within the first accumulation buffer 170. The counter value in the first accumulation buffer 170 corresponding to the pixel to which the color data from the drawing buffer 140 has been added is then incremented to reflect that another set of color data is included for that pixel in the accumulation buffer 170. Thus, if data from four images is accumulated for a pixel within the first accumulation buffer 170, the counter value for that pixel will reflect a value of four."

Nor does Morein teach a process for blending "each image pixel of the image X_K with the corresponding pixel of the image A_K", but instead only blends selected pixels for which a valid indication has been set as described at column 5, lines 47-60:

"When the controller 160 finds a pixel block indicator within the mask buffer 150 that is set, the controller 160 blends the color data for the valid pixels (as indicated by the valid indications in the drawing buffer) in the pixel block corresponding to the set pixel block indicator with the information corresponding to those pixels within the first accumulation buffer 170. In order to determine for which pixels valid color data exists within the drawing buffer 140, the controller 160 must examine both the pixel block indicators within the mask buffer 150 and the valid indications for the pixels stored within the drawing buffer 140. Both the pixel block indicator for a pixel block and the valid indication for a pixel within the pixel block must be set for valid data to be stored within the drawing buffer 140 for that pixel."

In addition, the blending process as taught by Morein, Haeberli, and MacInnis either singly or in combination does not teach or render obvious generating a "third stream of output pixels defining an image A_{K+1}" nor transfer the "third stream of output pixels to the accumulation buffer". In fact, the blending process as taught by Morein does not generate an image A_{K+1} nor transfer the image A_{K+1} to the accumulation buffer, but instead adds data from each image to the accumulation buffer and updates the counter value for each image as described at column 2, lines 7-37:

> "the accumulation buffer stores an accumulation data set for each pixel of the frame. Preferably, each accumulation data set includes accumulated color data and a counter value...When all of the images for a particular accumulation operation have been accumulated in the accumulation buffer, the color values stored in the accumulation buffer are normalized by dividing the color data value for a particular pixel by the counter value corresponding to the particular pixel."

The blending process as taught by Haeberli is similar to that of Morein in that for each new image, pixel data is added directly to the accumulation buffer as described at page 311 in Section 3.2:

> "The accumulation buffer provides 16 bits to store each red, green, blue, and alpha color component, for a total of 64 bits per pixel. The primary operations that may be applied to the Accumulation Buffer are: ...... 2. Add with weight. Each pixel in the drawing buffer is added to the accumulation Buffer after being multiplied by a floating-point weight that may be positive or negative."

MacInnis is silent on the use of an accumulation buffer to blend a sequence of images using the method as recited in claim 7.

Claims 17-22, and 32-33

Applicant respectfully submits that Morein, Haeberli, and MacInnis either singly or in combination do not teach or render obvious a system as recited in claim 17

comprising: an accumulation buffer; an image memory for storing a sequence of N images X_K, wherein K=0, 1, 2, ..., N-1; and a mixing unit configured to:

(a) read a first stream of image pixels corresponding to an image X_K from the image memory,

(b) read a second stream of pixels corresponding to an image A_K from the accumulation buffer,

(c) blend each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generate a third stream of output pixels defining an image A_{K+1}, and

(d) transfer the third stream of output pixels to the accumulation buffer;

wherein the mixing unit is further configured to perform (a), (b), (c) and (d) for each image after the first image of the sequence of N images.

The arguments presented above for claim 7 apply as well to claim 17, in that the mixing unit of claim 17 is configured to perform a blending method with several features as described in claim 7.

Second Ground of Rejection:

Claims 8, 18, 19, and 22 are finally rejected under 35 U.S.C. §103(a) as being unpatentable over Morein in view of Haeberli and MacInnis, and further in view of McReynolds ("Programming with OpenGL: Advanced Techniques". Siggraph Conference 1997, Course Notes for Course #11). Appellants traverse this rejection for the following reasons. Different groups of claims are addressed under their respective subheadings.

Claim 8

Claim 8 is dependent to claim 7, and therefore the arguments presented above in support of claim 7 apply as well to the method of claim 8.

Claims 18-19 and 22

Claims 18, 19, and 22 are each dependent to claim 17, and therefore the arguments presented above in support of claim 17 apply as well to the blending systems of claims 18, 19, and 22

Third Ground of Rejection:

Claims 20-21 and 24-33 are listed as finally rejected in the Office Action Summary, however, there are no stated grounds of rejection of claims 20-21 and 24-33 presented in the Final Office Action of December 27, 2005. Appellants traverse this rejection for the following reasons. Different groups of claims are addressed under their respective subheadings.

Claims 20-21:

There are no stated grounds of rejection of claims 20-21 presented in the Final Office Action of December 27, 2005.

Claim 24:

Claim 24 had been canceled prior to the Final Office Action of December 27, 2005.

Claims 25-29:

There are no stated grounds of rejection of claims 25-29 presented in the Final Office Action of December 27, 2005.

In addition, Applicant respectfully submits that Morein, Haeberli, and MacInnis either singly or in combination do not teach or render obvious a system as recited in claim 25 comprising: a memory for storing a plurality of 2D images X_K, wherein the plurality of 2D images include a sequence of at least N slices through a 3D image representing one or more 3D objects; an accumulation buffer; and an accumulation unit configured to accumulate a composite image of a sequence of N of the 2D slices by reading a first 2D image of the sequence and storing it in the accumulation buffer; wherein the <u>accumulation unit is further configured for each of the second through the Nth image of the sequence of N images to</u>:

(a) read a first stream of image pixels corresponding to a current image X_K of the sequence of images from the memory,

(b) read a second stream of pixels corresponding to a current image A_K from the accumulation buffer,

(c) blend each image pixel of the current image X_K with the corresponding pixel of the image A_K based on a weight provided with the image pixel, to generate a third stream of output pixels defining an image A_{K+1}, and

(d) replace corresponding pixels in the accumulation buffer with the third stream of output pixels.

The arguments presented above for claim 7 apply as well to claim 25, in that the accumulation unit of claim 25 is configured to perform a method with several features as described in claim 7.

The Examiner advises that should claim 28 be found allowable, claim 29 will be objected to under 37 CFR 1.75 as being a substantial duplicate of claim 28. Applicants note that claim 28 recites "the weight is a specified non-negative value less than or equal to 1 for <u>each image</u>" and therefore all objects within an image would have the same weight. Claim 29 recites "the weight is a specified non-negative value less than or equal to 1 for <u>each object</u>", and therefore each object has a specified weight and claim 28 is patentably distinct from claim 29.

Claims 30-33:

There are no stated grounds of rejection of claims 30-33 presented in the Final Office Action of December 27, 2005.

The arguments presented above for claim 7 apply as well to the methods of claims 30-31.

The arguments presented above for claim 17 apply as well to the systems of claims 32-33.

VIII. CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejection of claims 7-10, 17-22, and 25-33 was erroneous, and reversal of his decision is respectfully requested.

The Commissioner is authorized to charge the appeal brief fee of $500.00 and any other fees that may be due to Meyertons, Hood, Kivlin, Kowert, & Goetzel, P.C. Deposit Account No. 501505/5681-14000/JCH. This Appeal Brief is submitted with a return receipt postcard.

Respectfully submitted,

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IX. CLAIMS APPENDIX

The claims on appeal are as follows.

1-6. (Canceled)

7. (Previously Presented) A method comprising:

(a) reading a first stream of image pixels corresponding to an image X_K from an image memory;

(b) reading a second stream of pixels corresponding to an image A_K from an accumulation buffer;

(c) blending each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generating a third stream of output pixels defining an image A_{K+1}; and

(d) transferring the third stream of output pixels to the accumulation buffer;

(e) performing (a), (b), (c) and (d) for each image after the first image of a sequence of N images X_K, for $K = 0, 1, 2, \ldots, N-1$.

8. (Previously Presented) The method of claim 7, wherein the accumulation buffer color precision is larger than the image memory color precision.

9. (Previously Presented) The method of claim 7, wherein said blending comprises blending red, green and blue components of each output pixel in parallel.

10. (Previously Presented) The method of claim 7, wherein (a), (b), (c), (d) and (e) are performed by a graphics hardware accelerator chip in response to software functions executed on a host processor, wherein the image memory and the accumulation buffer are external to the graphics hardware accelerator chip.

11-16. (Canceled)

17. (Previously Presented) A system comprising:

an accumulation buffer;

an image memory for storing a sequence of N images X_K, wherein K=0, 1, 2, ..., N-1; and

a mixing unit configured to:

(a) read a first stream of image pixels corresponding to an image X_K from the image memory,

(b) read a second stream of pixels corresponding to an image A_K from the accumulation buffer,

(c) blend each image pixel of the image X_K with the corresponding pixel of the image A_K based on an alpha value provided with the image pixel, and thus, generate a third stream of output pixels defining an image A_{K+1}, and

(d) transfer the third stream of output pixels to the accumulation buffer;

wherein the mixing unit is further configured to perform (a), (b), (c) and (d) for each image after the first image of the sequence of N images.

18. (Previously Presented) The system of claim 17, wherein a color precision of the accumulation buffer is greater than a color precision of the image memory.

19. (Previously Presented) The system of claim 17, wherein the mixing unit includes a plurality of mixing circuits operating in parallel, wherein each mixing circuit operates on a corresponding color component.

20. (Previously Presented) The system of claim 17, wherein the accumulation buffer resides within a texture buffer of a graphics system.

21. (Previously Presented) The system of claim 17, wherein the image memory resides within a frame buffer of a graphics system.

22. (Previously Presented) The system of claim 17, wherein a color precision of the accumulation buffer is at least ΔN larger than a color precision of the image memory, wherein ΔN is the base two logarithm of the maximum number of images to be blended into the accumulation buffer.

23-24. (Canceled)

25. (Previously Presented) A system comprising:

a memory for storing a plurality of 2D images X_K, wherein the plurality of 2D images include a sequence of at least N slices through a 3D image representing one or more 3D objects;

an accumulation buffer; and

an accumulation unit configured to accumulate a composite image of a sequence of N of the 2D slices by reading a first 2D image of the sequence and storing it in the accumulation buffer;

wherein the accumulation unit is further configured for each of the second through the Nth image of the sequence of N images to:

(a) read a first stream of image pixels corresponding to a current image X_K of the sequence of images from the memory,

(b) read a second stream of pixels corresponding to a current image A_K from the accumulation buffer,

(c) blend each image pixel of the current image X_K with the corresponding pixel of the image A_K based on a weight provided with the image pixel, to generate a third stream of output pixels defining an image A_{K+1}, and

(d) replace corresponding pixels in the accumulation buffer with the third stream of output pixels.

26. (Previously Presented) The graphics system of claim 25, wherein the weight provided with each image pixel is a transparency value alpha read from the memory with each image pixel data.

27. (Previously Presented) The graphics system of claim 26, wherein said blend operation is described by a formula used for each pixel of $A_{K+1} = alpha *(X_K - A_K) + A_K$.

28. (Previously Presented) The graphics system of claim 25, wherein the weight is a specified non-negative value less than or equal to 1 for each image in the sequence of images.

29. (Previously Presented) The graphics system of claim 25, wherein the weight is a specified non-negative value less than or equal to 1 for each object of the one or more objects.

30. (Previously Presented) The method of claim 7, wherein the N images are a sequence of N 2D slices through a 3D image representing one or more 3D objects.

31. (Previously Presented) The method of claim 7, wherein said blending is described by a formula used for each pixel of $A_{K+1} = alpha *(X_K - A_K) + A_K$.

32. (Previously Presented) The system of claim 17, wherein the N images are a sequence of N 2D slices through a 3D image representing one or more 3D objects.

33. (Previously Presented) The graphics system of claim 17, wherein said blend operation is described by a formula used for each pixel of $A_{K+1} = alpha *(X_K - A_K) + A_K$.

X. EVIDENCE APPENDIX

No evidence submitted under 37 CFR §§ 1.130, 1.131 or 1.132 or otherwise entered by the Examiner is relied upon in this appeal.

XI. RELATED PROCEEDINGS APPENDIX

There are no related proceedings.